

Wireless Well Monitoring System

A Simple Solution for a Tough Problem

- By William H. Conley III

Introduction



Wireless Well Monitoring System

Having lived in the desert all my life, I've learned that the need for a clean, steady, reliable water supply is not optional, it's a necessity. It only takes one minor problem anywhere in the well system and the kids won't be swimming, the horses aren't happy and no one's taking showers. Like many wells large or small, the consequences of failure range from a nuisance to life threatening.

Increasing demand, aging components and desert temperatures exceeding 100 degrees in the shade put a strain on motors, causing fuses to blow or breakers to open. A large holding tank provides reserve capacity, but this also masks problems. It can take as long as two days for the tank to drain and the water to stop flowing. What is needed is a sure fire way to monitor all aspects of the well system and warn of any trouble before it becomes catastrophic. In most cases, the well site is located far from the homes it services. This makes wireless is a natural and cost effective solution.

Well System Overview



Holding Tank, Pressure Tank, Well Pump, & Control Panel

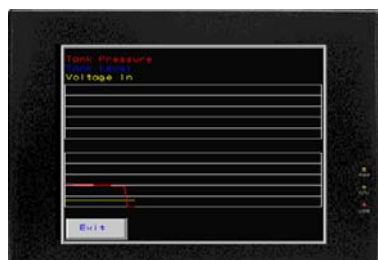
This well site is typical of southern Arizona. It feeds 12 rural homes situated on a 100 hundred acre development. It consists of a Well Pump located at a depth of 700 feet and submerged in 20 feet of water; a 15,000 gallon Holding Tank; a Pressure Pump; and a 1,000 gallon Pressure Tank used to provided water pressure. A control panel distributes power to the pumps and houses a very simple control system. The controls turn the Well and Pressure Pumps on and off as necessary to fill the Holding Tank and pressurize the Pressure Tank.



1000 Gallon Pressure Tank with Pressure Switch

The control system is nothing more than several float switches. The float switch follows the level in the Holding Tank. When the level drops about 3000 gallons, the float switch changes angle enough to close an internal contact. This energizes the Well Pump, which refills the Holding Tank.

A pressure switch monitors the Pressure Tank. The Pressure Pump forces water from the Holding Tank into the Pressure Tank. The pressure in this tank is a relative indication of how much water is pressurized, and, of course; how much water pressure is available to a respective home.



Sensor data is converted into a graphics page. All system parameters and information can be displayed and viewed by the user. Trending is a great way to determine how the system is performing. Knowing how often the well pump and pressure pump start and stop can allow a system to be fined tuned.



- Functional Device's RIBXK420-50 Loop Powered 4-20 mA current sensor Transmitter
- Flowline's LU12-5001 Fluid level 4-20 mA Transmitter
- ColeParmer's EW-68902-34 Pressure 4-20 mA Transmitter

The Remote Monitoring System

I needed the ability to monitor well system performance, water inventory, pump status, and the water delivery pressure. With my home located across a road and over 800 feet from the well, a wireless solution was an attractive option. This would give me the ability to glance at a monitoring panel in the comfort of my living room to view the Holding Tank level, see if the pumps are on or off, how much current was being drawn, and look at how much pressure was in the pressure tank. I promptly went to work designing such a system.

As a developer of B&B Electronics' Zlinx™ wireless I/O product line, these were an easy choice to use for the building blocks of my system. I used the ZZ9D-NA-LR Zlinx™ I/O Module and the ZP9D-115RM-LR wireless modem. My biases aside, they are reliable wireless devices that allow connectivity to almost any type of sensor, and they support Modbus!

The Zlinx™ wireless I/O system is modular, allowing you to simply snap on additional I/O to add more analog and digital inputs and outputs if you wish to increase monitoring capabilities. Once you get the basic solution in place, it's easy to let your imagination run wild with ideas on how to expand the system.

Sensors

The goal was to monitor the basics. This included water level in the Holding Tank, AC current drawn from the Well and Pressure Pump and the pressure in the Pressure Tank.

Wherever practical, I like to use sensors with a conditioned current output (4-20mA). A current type sensor eliminates most induced noise and can easily support longer connection lengths.

Also, keep in mind that you should use a sensor/transmitter with a full scale measurement greater than what's being monitored. In other words, if you plan on measuring a motor with a max current draw of 20 Amps, select a current sensor with a full scale of 50 Amps. While you sacrifice some resolution, my experience has been that it provides the opportunity to catch potential failure modes that you would miss if the sensor maxed out at rated load.

I chose 50 Amp current sensors, one on each leg of the incoming 220V power cable. A 50 Amp current sensor was used to detect any problems with the motor in case it starts to go bad. Large current draw is an excellent indicator of Start or Run capacitors going bad.

Make sure you are using a level ‘Transmitter’, not a level switch or other device, it’s sometimes confusing. Flowline’s LU12-5001 Level Transmitter was selected because of the low cost and it gave a 4-20ma output signal with respect to a 4” to 40’ depth detection.

As an electronics guy, mounting the level sensor was one of the most difficult parts of the project. It required mounting the sensor as well as running conduit to install the wiring.

The pressure sensor outputs a 4-20ma current signal with respect to its full scale measurement of 0-100psi. It simply took the place of the old pressure gauge.

HMI Programming

HMI is an abbreviation for “Human Machine Interface”. Typically HMI’s are devices that allow a user to display information and to allow some simple on/off control of devices such as pumps.

For the most part, programming the device is simple. B&B Electronics carries a line of Maple Systems HMI’s and through some time and patience you can develop a monitoring system much like the one show here. The program for this project is available for free download. If you’ve got a project like mine you can use it as is, or it can be an excellent starting point to modify it for your exact application.

Zlinx™ Configuration

I’ve included detailed information on how to configure Zlinx for this application in a separate document. Fundamentally, I used the Zlinx™ configuration software to adjust radio settings, set the I/O to Modbus mode, and configure the inputs.



The HMI can display as much or as little sensor data as desired.

Easy Implementation

If you desire to implement a system similar to the one described here, I've put together a kit which includes all of the items required, including software, in a simple to install kit. Visit B&B Electronics' web site for more information.

What's next

I reserved the two Digital Inputs on the Zlinx Base module to allow for monitoring water flow from the well to the holding tank and outgoing water from the pressure tank to all the homes. This will allow me to remotely monitor and display an electronic water meter.

In some applications, it's important to measure water "draw down". Water draw down typically happens when the well pump first comes on and the water table drops. This can damage a pump if the water table falls below the pump.

Use your imagination! This system is easily expandable by snapping on more I/O modules and connecting them to whatever sensors you can imagine. For my system, it's easy to envision adding a large array of sensors such as water meters, flow meters, PH sensors, etc.

Yea! The Zlinx™ series I/O devices can do that and then some!

Bill Conley is an Engineer at B&B Electronics and is in charge of our Southwest U.S. Regional Office. He is the focal point of our Zlinx™ Wireless product line as well as many other innovative products.

B&B Electronics started in 1981 manufacturing a single product, an RS-232 tester. Since then B&B has had continuous growth in industrial communications and automation. For a library of technical information and one of industry's most popular industrial electronics and communications catalogs, visit www.bb-elec.com